2 AUDIO MODULE

2.1 Objectives

2.1.1 Understand and explain the nature of sound and how it is captured in a recording.

2.1.2 Understand and explain the various instruments used in analyzing sound (FFT spectrum analyzer, equalizer, etc.).

2.1.3 Understand and explain the two categories of noise and how they relate to sound analysis.

2.1.4 Understand and explain the three types of distortion encountered in audio signals.

2.1.5 Understand and explain the operation of voice recorders.

2.1.6 Understand and explain the most common limitations of analog playback (distortion, speed errors, wow/flutter, noise floor, bandwidth, crosstalk).

2.1.7 Gain the capability to recognize the various tape formats and know their associated speeds.

2.1.8 Understand and explain the advantage of digital tape recorders over analog.

2.1.9 Understand and explain the various signal processing filters and how they are used in forensic audio analysis.

2.1.10 Gain the capability to use audio enhancement software and hardware.

2.1.11 Gain the capability to do routine maintenance and upkeep of audio hardware.

2.2 Methods of Instruction

2.2.1 Lectures

- 2.2.1.1 PCAP and its uses
- 2.2.1.2 Noise
- 2.2.1.3 Tape formats
- 2.2.1.4 Digital vs. analog recording

2.2.2 Literature Review

- 2.2.2.1 Equipment and Software Users Manuals
- 2.2.2.2 Audio sections of the Division of Forensic Science - Imaging/Audio Procedure Manual

2.2.3 Training Programs

- 2.2.3.1 SignalScape Video and Audio -- Proficient operation of the software as it pertains to audio analysis.
- 2.2.3.2 DPS Video and Audio -- Proficient operation of the software as it pertains to audio analysis; to include use of editing tools.
- 2.2.3.3 Sound Forge -- Proficient operation of the software as it pertains to audio analysis.
- 2.2.3.4 PCAP -- Proficient operation of the software as it pertains to audio analysis.

2.2.4 Demonstration

- 2.2.4.1 Basic enhancement techniques will be observed from beginning to end and notes will be taken by the trainee

2.2.5 Laboratory Exercises

- 2.2.5.1 Distance recording experiment
- 2.2.5.2 Microphone vs. pickup for telephone recordings

2.2.5.3 Cell phone vs. landline phone enhancement

2.2.5.4 PCAP training tape

2.2.5.5 Casework will be completed by trainee under supervision – content and techniques used will be dependent on the cases submitted

2.3 Evaluation

2.3.1 Written examination

2.3.2 Laboratory testing

- Trainee must complete at least 9 months of casework under direct supervision. This may include real and mock cases.

2.3.3 Oral exercises

- Technical review sessions

2.3.4 Courtroom exercises

- Trainee must be capable of answering questions such as would be expected in a courtroom scenario.

2.4 Examination Questions

2.4.1 How is an audio recording made?

2.4.2 What are the two categories of noise and what are the properties of each? Give and example of each.

2.4.3 Name three types of distortion encountered in audio signals.

2.4.4 Match the correct tape speed with the correct tape format

Standard Cassette	1 7/8 ips
Microcassette	15/16 ips

2.4.5 Explain the advantage of digital tape recordings over analog recordings.

2.4.6 Define the following terms:

- Dynamic Range
- Octave
- Impedance
- Noise
- Crosstalk
- Azimuth
- Signal-to-Noise Ratio
- Attenuation
- Additive Noise

- Convolutional Noise
- Transfer Function
- Tonal Noise

2.4.7 Explain extraction of audio from video recordings.

2.4.8 Explain the difference between balanced and unbalanced inputs.

2.4.9 Explain multi-directional, parabolic, and shotgun microphones.

2.4.10 What is the speed of sound in air at 21 degrees C?

2.4.11 What is the range of frequencies typically analyzed in forensic audio processing? Why?

2.4.12 What is the dynamic range of analog tape?

2.4.13 Briefly explain each of the following filters/audio level controls:

- Highpass
- Lowpass
- Bandpass
- Bandstop
- Notch
- Slot
- Graphic Equalizer
- Parametric Equalizer
- Limiter
- Automatic Gain Control
- Compressor/Expander
- Comb
- Spectral Inverse
- One Channel Adaptive

► End